Navicular Rise: a possibility to describe dynamic foot function during stance?

A descriptive, cross-sectional laboratory study

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Background

➢ The prevalence of adult acquired flatfoot is up to 19% [1], and therefore a frequent problem in daily physiotherapy practice.
➢ Quantifying the navicular drop (ND) with 3D-motion capturing methods during stance is an established laboratory method [2].
➢ So far, only the ND is assessed, but there is also a rise of the navicular bone (navicular rise = NR) at the end of stance phase due to the windlass mechanism[3].

Purpose

The aims of this cross-sectional laboratory study were the description of a new measure, the navicular rise (NR) during stance and the comparison of NR with the established measure navicular drop (ND).

Methods

Equipment

➢ 3D-motion system (Vicon©) with 10 infrared cameras
➢ 2 force plates to determine stance phase (initial contact to toe-off)
➢ 4-marker foot model with reflective markers on calcaneus, navicular bone, 1st and 5th metatarsal head (Fig. 1a & b)

Measurements

➢ 2 measurements (M1a, M1b) on one day, 1 measurement one week later (M2) for intra- and interday reliability
➢ 2 tasks: level walking and stair descent
➢ 10 trials for each task -> mean curves for each task and measurement point -> calculation of navicular heights

Results

➢ Walking: mean NR = 12.2 (±3.7) mm overall; stairs: mean NR = 14.8 (±3.4) mm overall
➢ Mean and SD of the NR at M1a, M1b, M2 (Fig. 3a & b)
➢ Relationship between ND and NR at M1a (Fig. 4a & b)

Conclusion & Implications

➢ For level walking, the NR may rather not be an independent measure for late stance dynamics. For stair climbing, the NR resembles the ND and therefore, gives no additional information for dynamic foot function during late stance.
➢ As only healthy subjects had been measured, the results cannot be transferred to patients. Future research should include larger sample sizes or focus on patient groups.
➢ Even though not every person with flatfoot gets symptoms, it is worth to know the biomechanical consequences for posture and motion to support prevention for the known associations with foot or low back pain and medial tibial stress syndrome.

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Ethics Approval

This study was approved by the Ethics Committee of the Canton Bern (CH) (KEK-Nr. Z07/12).

References


Fig. 1a & b: Application of reflective markers and frontal view on feet

Fig. 2: Navicular bone motion (blue line) and ground reaction forces (green line) during stance

Fig. 3a & b: Boxplots for NR at different measurement points

Fig. 4a & b: Scatterplots showing relationship between ND and NR